AMENDMENTS TO THE DRAWINGS:

A replacement sheet including Figure 4B is filed herewith. Figure 4B is amended to include references 202, 204.

REMARKS

Claims 17-19, 21, 23-26, and 28-37, 39-50, 52-61 are pending. By this Amendment, the specification, title and Abstract are amended, Figure 4B is amended, Claims 20, 38 and 51 are canceled, and Claims 17-19, 21, 23-26, 28-29, 31-32, 34-36, 39-45, 47-50, and 52-56 are amended, and new Claims 57-61 are added. Claim 61 includes a feature formerly recited in Claim 36.

Applicants appreciate the courtesy extended by the Examiner to Applicants' undersigned representative during the 28 April 2005 personal interview, when operation of the claimed device and the disclosure in the application were discussed. Substance of the interview is variously incorporated below.

The amendments to the application do not introduce new matter into the application. In particular, the specification is amended to ensure it includes a succinct description of operation of the claimed device.

Objection to Specification & Rejection under 35 U.S.C. § 112, 1st ¶

In the Office Action, the Examiner objects to the clean copy of the substitute specification filed on 24 October 2004, on grounds that the sentence on lines 20-22 of page 5 is incomplete. Applicants respectfully submit that the Substitute Specification filed herewith obviates this objection. Withdrawal of the objection is respectfully requested.

In the Office Action, the Examiner also objects to the specification on grounds that the descriptions therein are unclear, and rejects Claims 18-21, 23-26, 29, 31-32, 34-37 and 40-50 under 35 U.S.C. 112, 1st paragraph. Applicants respectfully submit that the Substitute Specification filed herewith contains descriptions with increased clarity, even though the originally filed application would have enabled a person of

ordinary skill in the art at the time of the invention, to make and use the claimed invention, as discussed during the personal interview. For example, as discussed during the personal interview, basic sensors and indicators were well known in the art and in many cases available as off-the-shelf components or systems, at the time of the invention, and thus the person of ordinary skill would have been able to build a locking device as variously claimed, including indicator lamps, mechanical arrows and so forth. In addition, the term "interlock" has been replaced with the term "lock" in the specification and claims. Withdrawal of the objection to the specification and the rejection of Claims 18-19, 21, 23-26, 29, 31-32, 34-37 and 40-50 under 35 U.S.C. 112, 1st paragraph is respectfully requested.

Descriptions of Exemplary Embodiments

In an exemplary embodiment, an actuator opens and closes breaker contacts via a rod system. The actuator can be mechanically and electrically locked, for example when the breaker contacts are in an open or disconnected position. The rod system can also be mechanically locked, for example by a blocking plate, to ensure that the breaker contacts will remain open. These redundant locks that maintain the breaker contacts in the open or OFF position can be used, for example, to prevent injury to human personnel who are repairing or working on the system and would be endangered if the breaker contacts were closed or energized. In one embodiment, locking of the actuator is achieved when an electromagnet positions a locking shackle that physically blocks operation of the actuator, and then power to the electromagnet is cut off to immobilize the shackle, thereby achieving both electrical and mechanical locking of the actuator. In another embodiment, locking of the actuator is achieved by releasing an electromagnet both cuts off power to the

actuator and releases a locking shackle so that the locking shackle drops into a position physically blocking operation of the actuator, thus electrically and mechanically locking the actuator. In an exemplary embodiment, if the actuator is in the ON position when steps are taken to lock the actuator, the steps can trigger automatic actuation or switching of the breaker contacts to the OFF position so that the actuator will be locked with the breaker contacts in the OFF position. In an exemplary embodiment, after the actuator and the rod system have been locked in the open or OFF position, an earth knife can be actuated to connect the breaker to earth or ground, and the earth knife can be locked in that connected position.

For example, in an exemplary embodiment, turning the first key 18 in the lock 14 mechanically and electrically locks the blocking package 11 of actuator 10, where the blocking package 11 controls a position of the breaker contacts 30. Specifically, turning the first key 18 in the lock 14 releases the electromagnet 12, thereby interrupting operating current to the blocking package 11. Releasing the electromagnet 12 also allows the locking shackle 13 to be released downwards to mechanically prevent movement of the blocking package 11 from the OFF position to the ON position. Then, the first key 18 can be inserted into the second lock 22. Turning the first key 18 in the second lock 22 allows the blocking plate 23 to be manually moved to lock the rod system 20. After the blocking plate 23 is manually moved sideways to a position where it mechanically blocks or locks the rod system 20 in the OFF position. Turning the second key 24 in the third lock 25 mechanically locks the blocking plate 23 in the position where the blocking plate 23 is locking the rod system 20.

Action of the blocking plate 23 is described in greater detail with respect to Figure 4B in the Substitute Specification filed herewith. In addition, Applicants submits a copy of U.S. Patent No. 4,414,440 to DeCoste, which discloses a blocking plate mechanism known in the art at the time of the present invention, and which further establishes that persons of ordinary skill in the art at the time of the invention would have been able to make and use the invention described in the application, including the blocking plate mechanism(s) shown for example in Figures 4B, 6B of the present application.

Additional exemplary features include an auxiliary contact 17 indicates the position of the breaker contacts, and when the breaker is OFF and the actuator/blocking package is locked, a signal from the auxiliary contact 17 is supplied via the cable 60 to the actuator 50 of the earth knife, to allow the earth knife to 40 to be moved to a position where it earths or grounds the breaker. Lighting of the green lamp 19 and/or position of a mechanical arrow 16 can be used to indicate locking of the actuator/blocking package. For example, those skilled in the art at the time of the invention would have recognized that the green lamp 19 can be used to indicate electrical locking, and the mechanical arrow 16 can be used to indicate mechanical locking.

Claim Rejections under 35 U.S.C. § 102(b)

In the Office Action, the Examiner rejects Claims 17, 39, 51-52 and 54 under 35 U.S.C. § 102(b) over U.S. Patent No. 5,477,016 to Baginski, *et al.* (Baginski). The Examiner also rejects Claims 17-21, 23-26, 31, 33, 39-40, 43, and 51-52 under 35 U.S.C. § 102(b) over U.S. Patent No. 5,584,378 to Wecke, *et al.*(Wecke). These rejections are respectfully traversed.

Wecke discloses a safety switch assembly that double-locks a protective screen in place around a motor, and supplies power to the motor when both of the locks are locked. The first lock locks the screen, and the second lock locks the first lock.

In particular, Wecke discloses that inserting a key into a screen lock 2 locks a protective screen or housing 1 around a motor driven machine, and turns on a switch to supply power to a motor M. The key turns on the switch 4 by drawing a plunger 3 upward to rotate a cam 5 via a pin 14, and the cam 5 actuates the electrical switch 4 via an element 13. An electromagnetic locking mechanism 6 performs the double or second locking function, by pushing a lever 8 upwards after the key has been inserted into the screen lock 2, to engage a lug of the cam 5 and lock the position of the cam 5 to thereby lock the switch 4 in the actuated position and lock the key in the screen lock 2. The lever 8 also actuates a monitoring switch 7, so that when the cam 5 is locked by the lever 8, the monitoring switch enables operation of the motor and when the cam 5 is not locked by the lever 8, the monitoring switch disables operation of the motor. The locking mechanism 6 is disclosed as having a spring for pressing the lever 8 into engagement with the locking lug of the cam 5, and an electromagnet for drawing the lever 8 out of engagement with the locking lug of the cam 5 against the spring pressure. See for example column 4, lines 13-23. Figure 3 shows an alternate arrangement wherein the spring of the mechanism 6 pulls the lever 8 out of engagement with the locking lug of the cam 5, and actuation of the electromagnet in the mechanism 6 opposes the spring pressure to lock the cam 5 via engagement of the lever 8 with the locking lug of the cam 5.

Baginski discloses a circuit breaker wherein a bar 18 actuates switch contacts 16, 22, 24, is double-locked by a latch 38 that immobilizes (locks) the bar 18, and a padlock 70 that immobilizes the latch 38. See for example Figures 3-4 and column 4, lines 15-19.

However, Wecke and Baginski each fail to disclose or suggest a disconnecting breaker including at least one set of breaker contacts, an actuator mechanically connected to said at least one set of breaker contacts by a linking system, wherein said actuator controls the position of the breaker contacts between a closed position and an open position, a mechanical first lock that blocks the movement of the linking system and maintains said at least one set of breaker contacts in the open position, and a second lock that locks the actuator to prevent actuator control of the breaker contacts, wherein the second lock includes an electrical lock that interrupts control power to the actuator and prevents actuator control of said at least one set of breaker contacts, as recited in Claim 17, and similar features recited in independent Claims 21, 24 and 39.

Accordingly, withdrawal of the claim rejections under 35 U.S.C. § 102(b) over Wecke and Baginski is respectfully requested.

Claim Objections

In the Office Action, the Examiner objects to Claims 17, 34, 38 and 52-53. Applicants respectfully submit that various amendments to Claims 17, 34 and 52-53, and cancellation of Claim 38, obviate this objection. Withdrawal of the objection is respectfully requested.

Conclusion

Applicants respectfully submit that the application is in condition for allowance. Favorable consideration on the merits and prompt allowance are respectfully requested. In the event any questions arise regarding this communication or the application in general, please contact Applicants' undersigned representative at the telephone number listed below.

Respectfully submitted,

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Date: 12 July 2005

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Marked-up

SUBSTITUTE SPECIFICATION

METHOD AND DEVICE FOR ~~INTERLOCKING~~ LOCKING

The present invention concerns a method and a device for ~~interlocking~~ locking a circuit breaker and a grounding switch in order to be used as a disconnecting breaker.

The prior art

Switching of power lines, cables, power transformers, etc. is done by circuit breakers. Safety regulations have earlier required a ~~disconnecting breaker~~ disconnector with a visually open conductor spacing during work on, for example, a high voltage switch gear. According to the traditional solution, a breaker and a ~~disconnecting breaker~~ disconnector have together ensured that the section of the equipment where the work is to be carried out is disconnected. This type of solution requires at least one, and often two, ~~disconnecting breaker~~ disconnectors with demanding maintenance in order to ensure their correct function. Each disconnecting breaker must be correctly installed with a foundation that requires space and expensive installation time. The present invention is intended to solve the problems described above. The intention is to provide a compact solution, reliable from the point of view of safety, that is simple to manufacture and cost-effective for the customer. The construction permits manufacture of the parts according to known technology.

Summary of the invention

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The present invention concerns a method and a device for ~~interlocking~~ locking a circuit breaker and a grounding switch to be used as a disconnecting breaker. The earlier requirement for a visually open ~~disconnecting breaker~~ disconnector has been replaced according to new regulations by the requirement for a reliable indication that ~~the~~ a section of the equipment is disconnected. The disconnecting breaker replaces a circuit breaker, one or two series connected disconnectors, and means for grounding. The disconnecting breaker can be either of single-pole type or multiple-pole type depending on its operating voltage.

During ~~interlocking~~ locking of a single-or multiple-poled disconnecting breaker that includes a linkage system, known as a "rod system", for closing and opening operation of the contacts of the breaker, the actuator of the breaker is first ~~interlocked~~ locked ~~both~~ electrically and/or mechanically, after which the linkage system may also be solidly locked by a mechanical device. When the breaker is in the open position, the distance between the contacts of the breaker constitutes the conductor spacing of the disconnecting function, and is large enough to provide the electrical insulation required for the disconnecting function. The electrical and mechanical ~~interlocking~~ locking of the actuator is indicated both electrically and mechanically by suitable indicators (lamp, arrow, etc.). Following the safe locking of the breaker in the open position, the grounding switch can be operated to safely ground one of the breaker terminals.

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The ~~interlocking~~ locking of the actuator of the breaker is achieved with the aid of an electromagnetic blocking unit that can be operated with a hand-operated key-and lock device. The blocking unit can in one preferred embodiment be operated by remote control, e.g. by interrupting the control power to the actuator. In one preferred embodiment, operation of ~~the~~ a hand-operated key-and lock device controls an electromagnet that ~~interlocks~~ locks a blocking package of the actuator of the breaker by both breaking the operating current to the actuator and by mechanically blocking the actuator. The key device is freed from the lock device following the ~~interlocking~~ locking of the actuator of the breaker and is used in a second lock device for mechanical ~~interlocking~~ locking of the rod system with the aid of a blocking unit. The rod system is locked in the ~~interlocked condition~~ open breaker position with a second key device and a third lock device. The ~~interlocking~~ blocking of the rod system is indicated by at least one indicator.

According to one embodiment of the device, the second key device is used with a fourth lock device in order to free a blocking unit, which makes it possible to move a grounding switch, also known as an earth knife or other earth device. Once the earth knife has been connected to one of the breaker contacts, the earth knife is blocked in its connected position and locked with the second key device and the fourth lock device.

The electrical and mechanical ~~interlocking~~ locking of the actuator of the breaker can in one preferred embodiment be achieved with a remote-

controlled ~~interlocking~~ locking device. The remote-controlled ~~interlocking~~ locking of the actuator of the breaker is indicated by electrical and mechanical indicators on the breaker and by indicators on the remote-control unit. ~~The~~ In an exemplary embodiment the remote-controlled ~~interlocking~~ locking device includes the operation of a blocking device for the earth knife, ~~after~~ during which operation, movement of the earth knife causes ~~interlocking~~ blocking of the rod system. The system according to the invention is very reliable from the point of view of safety due to the ~~interlocking~~ locking in one preferred embodiment being performed by the exchange of keys, and due to electrical and mechanical indicators showing in multiple ways that the breaker is ~~interlocked~~ safely locked to prevent any operation.

Brief description of the figures

Fig. 1 shows a sketch of the principle of a disconnecting breaker for a three-phase system.

Fig. 2 shows a sketch of the principle of a disconnecting breaker for a single-phase system.

Figs. 3A-3C show an actuator (a), including an electromagnet (b) and an external surface (c) for operation of a breaker.

Figs. 4A-4B show ~~interlocking~~ locking of the rod system (a) with a blocking plate and lock (b).

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Fig. 5 shows an actuator for an earth knife together with ~~interlocking~~ locking of the earth knife with a blocking unit equipped with a lock.

Figs. 6A-6C show the disconnecting breaker with earth knives (a), blocking device (b) and rotating disk (c) of the ~~interlocking~~ locking arrangement of the rod system during remote control.

Detailed description of preferred embodiments

Fig. 1 shows a sketch of the principle of a disconnecting breaker for three poles. An actuator 10 controls a link system, known as a rod system, 20 which connects the poles together and controls the positions of the contacts 30 of the breaker. The positions of the contacts 30 of the breaker are indicated on each pole, for example with a mechanical arrow 70. An earth knife 40 is controlled by its own actuator 50, which is in direct electrical connection with the actuator 10 through a cable 60 connected between the actuators. When the disconnecting breaker is ~~interlocked~~ locked, the actuator 10 is first ~~interlocked~~ locked both electrically and mechanically with the aid of an electromagnet 12. After this, the rod system 20 of the breaker 30 is ~~interlocked~~ locked mechanically. The indication is achieved in one preferred embodiment electrically with a lamp and mechanically with, for example, an arrow. The key-and lock device in one preferred embodiment is a Castel lock with the associated keys. When both the actuator 10 and the rod system 20 are ~~interlocked~~ locked, manual operation and locking of the earth knife 40 according to known technology are possible.

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Fig. 2 shows a sketch of the principle of a disconnecting switch for a single pole. An actuator 10 controls a link system, also known as a rod system, 20 which controls the position of the breaker contacts, e.g. the contacts 30 ~~of the breaker~~. The positions of the breaker contacts ~~30 of the breaker~~ are indicated, for example, with a mechanical arrow 70. An earth knife 40 is controlled by its own actuator 50, which is in direct electrical connection with the actuator 10 through a cable 60 connected between the actuators. When the single-pole disconnecting switch is ~~interlocked~~ locked, the breaker is ~~interlocked~~ locked according to the same principle as the three-pole disconnecting switch.

One embodiment of the present invention provides a device for ~~interlocking~~ locking a circuit breaker in an open or closed position. In this embodiment, a set of breaker contacts operated by a linking system ~~which~~ is in mechanical communication with an actuator. Operation of the actuator, in turn, moves the set of breaker contacts into either an open or closed position by moving the linking system. The position of each of the set of breaker contacts may be indicated by an indicator, for example, by a mechanical arrow. In addition to operating the linking system to open or close the set of breaker contacts, the actuator may further contain devices for ~~interlocking~~ locking the linking system in the open or closed position by both mechanical and electrical means.

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Operation of the breaker is controlled by an actuator driving the linking system. An electromagnet is used to position at least one locking shackle so as to mechanically prevent operation of a blocking package, which mechanically prevents operation of the actuator ~~and maintain~~ thereby maintaining the set of breaker contacts in the open or closed position. Electrical ~~interlocking~~ locking is achieved by disconnecting the operating current to the electromagnet operating the locking shackle after positioning this locking shackle. Therefore, once electrical ~~interlocking~~ locking has occurred, the positioned locking shackle may not be retracted by the electromagnet until such current is restored. Electrical ~~interlocking~~ locking may be indicated by mechanical and/or electrical indicators present on the actuator, for example, by illumination of a green lamp and/or a mechanical arrow pointing to a green field.

In one embodiment, the far end of the rod attached to the actuator extends outward from the outer breaker pole housing when the breaker contacts are in the open position and thus allows for it to be mechanically ~~interlocked~~ blocked by a physical connection, for example, to a blocking plate or other similar device to prevent the rod from moving once the breaker is in the open position. The visible extension of the rod upon placing the breaker contacts in the open position further serves as an indicator that the breaker is in an open position and ~~allowing for interlocking to take place~~ allows for closing of the earth knife. The position of the blocking plate can be

designed to serve as an indicator that ~~interlocking~~ blocking by the blocking plate has been achieved.

Figs. 3A-3C show the actuator 10 for control of the rod system 20 and thus the position of the contacts ~~30, which~~ 30. The actuator 10 includes a blocking package 11 that solidly prevents mechanical movement of the actuator 10 and thus also any operation of the breaker contacts. The blocking package 11 prevents operation ~~controls the position~~ of the breaker 30 together with an electromagnet 12 equipped with a mechanical locking shackle 13 or equivalent device. The mechanical locking shackle 13 or equivalent device mechanically prevents any unintended movement of the blocking package. When a first key 18 is turned in the lock 14, the electromagnet 12 releases, ~~whereby~~ and operating current to the blocking package ~~11, which is used for control of the rod system and thus the breaker,~~ 11 is interrupted. The blocking package 11 is locked by breaking its operating current and by turning off the operating current to the electromagnet 12 equipped with the mechanical locking shackle 13. Under the condition that the breaker is in the OFF position, the shackle 13 is released downwards and mechanically blocks movement of the blocking package from the OFF position to the ON position. Indication that ~~interlocking~~ locking of the actuator is achieved may, for example, be realized by the lighting of a green lamp 19 on the external surface of the actuator and by ~~the~~ a mechanical arrow 16 pointing towards a green field of a mechanical

arrow 16 inside the actuator. An auxiliary contact 17 provides electrical interruption or closing of a signal, which indicates the position of the breaker. When the breaker is OFF and the actuator is ~~interlocked~~ locked, a signal is sent ~~from~~ via the auxiliary contact 17 ~~via~~ and the cable 60 to the actuator 50 of the earth knife. This is one of the conditions that must be satisfied if movement of the earth knife is to be possible. If the breaker is in the ON position when the actuator is ~~interlocked~~ locked, the breaker can in one preferred embodiment be automatically switched over to the OFF position. In one preferred embodiment the actuator of the breaker can be ~~interlocked~~ locked with the breaker in the ON position. The indicator 70 then indicates that the breaker is in the ON position. Movement of the earth knife is not possible in this condition since this requires a signal ~~from~~ via the auxiliary contact 17 ~~via~~ and the cable 60 to the actuator of the earth knife.

Figs. 4A-4B show part of a link system, known as a rod system, 20 for operation of the contacts 30 of the breaker. The rod system 20 is equipped with a moving part 21 that is in an inner position when the breaker is ON and an outer, visible position when the breaker is OFF. Figure 4B shows an exemplary blocking plate 23. As can be seen with respect to Figure 4B, a hole in the blocking plate 23 includes a first region 202 large enough to permit the moving part 21 to move or rotate freely, and a second region 204 that is smaller than the first region 202. As can be seen from Figure 4B, the second region 204 is large enough to receive the moving part 21 when the

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moving part 21 is rotated 90 degrees to align with the second region 204, and will prevent the moving part 21 from rotating when the moving part 21 is in the second region 204, e.g. after the blocking plate 23 has been pushed in a sideways direction. By turning the first key 18 in a second lock 22, manual movement of a blocking plate 23, or other blockage device, is made possible. The ~~blockage~~ blocking plate 23 is pushed in a sideways direction and locked in place with a second key 24 in a third lock 25 such that the moving part 21 and thus the rod system 20 are locked into ~~their outer~~ positions corresponding to open breaker. The ~~interlocking~~ locking of the rod system can be indicated with, for example, an arrow.

Fig. 5 shows the earth knife 40 with its actuator 50. The position of the earth knife is controlled by a link system 51.

Figs. 6A-6C show the design of the rod system when remote-controlled ~~interlocking~~ locking is used. Movement of the earth knife involves movement of the blocking plate 23 via a rotatable disk 80.